at Rome by decree of Victor Emmanuel in 1874, and is probably one of the finest and most complete educational museums in the world. It is freely open to the public, and teachers have ample facilities for taking advantage of its circulating library, and of the various other means which it possesses for furthering the cause of higher education.

A NEW French geographical journal has been established by M. George Renaud, a member of the Paris Geographical Society, under the name of the *Journal Géographique Internationale*, which will be published twice a month. Each number will contain a coloured map.

MR. CUNLIFFE OWEN, the director of the South Kensington Museum, visited on Saturday last the photographic workroom established in the *Moniteur* office, Quai Voltaire, Paris. The peculiarity of the process used is the reproduction of colours by a series of chromo-printings. It is a combination of photography and chromo-lithography, which gives astonishing results, chiefly in the reproduction of models of engines and *natures mortes*.

THE March part of the *Geographical Magazine* contains two maps by Mr. Ravenstein, in connection with Lieut. Cameron's recently-accomplished journey across Africa. One of these is of a portion of South Africa, illustrative of Cameron's route from Lake Tanganyika to the west coast, and the other is a map of the country between Lake Tanganyika and Nyangwe, according to Livingstone and Cameron. The same number contains an interesting account by Lieut. Liardet of an ascent to the lake on the summit of the island of Taruini, in Fiji.

"THE Study of Natural Science" is the title of an address delivered to the Natural Science Classes in the University College of Wales, by Mr. F. W. Rudler, F.G.S., recently appointed Professor of Natural Science in the College. Mr. Rudler has sound notions as to the relations which ought to subsist between scientific and literary training in education, and of the methods which ought to be followed in the study of science.

WE have received a copy of the rules, list of members, and Papers read before the Cambridge Natural Science Club. The number of members is very limited, and the rules are sufficiently stringent to exclude all but men who mean to work. Some of the papers which have been read are of permanent value.

WE are glad to see that the Edinburgh Naturalists' Field Club, founded in 1869, is still in existence and evidently in a prosperous condition.

FROM its Tenth Annual Report, we are glad to learn that the North Staffordshire Naturalists' Field Club is in a prosperous condition; the number of members is now 330. The excursions and meetings during the past year appear to have been instructive and interesting. The Report contains the Annual Address of the President, Mr. C. Lynam, on the Sepulchral Monuments of Staffordshire. Other papers are: "The Geology of Needwood Forest," by Mr. W. Molyneux, F.G.S.; "Uriconium," by the Rev. J. S. Broad; "Ancient Church Bells in Staffordshire," by Mr. C. Lynam; and "Structural Features of Plants in relation to their uses in the Arts and in Medicine," by D. J. T. Arlidge.

PART 3 of Vol. I. of the *Transactions* of the Watford Natural History Society contains the following papers:—On the Botanical Work of the past Season, by R. A. Pryor, F.L.S., with a map of Hertfordshire; List of Works on the Geology of Hertfordshire, by W. Whitaker, F.G.S.; and A Few Words about some Local Ferns, by J. E. Littleboy.

IN the last-issued part of the Transactions of the Institution of Engineers and Shipbuilders in Scotland is a paper by Mr. James Brownlee "On the Action of Water and Frictional Resistance or Loss of Energy when flowing at various velocities through a nozzle with a converging entrance and diverging outlet," with two plates.

THE President and Fellows of Magdalen College, Oxford, have commenced free courses of lectures on botany, zoology, and chemical physics, for artisans resident in Oxford. They will be continued throughout the present and Easter Term and the Long Vacation on each Saturday evening. The lectures are conducted by Prof. Lawson and Messrs. Chapman and Yule.

MESSRS. LEWIS AND CUNNINGHAME, special assistants to the Sanitary Commissioners with the Government of India, have just published a Report describing a series of important observations on the Soil in its relation to Disease.

"LIST of Hemiptera of the Region West of the Mississippi River" (extracted from the *Bulletin of the Geological and Geographical Survey of the Territories*, No. 5, second series, Washington, January, 1876) is the title of a pamphlet by Prof. P. R. Uhler, who has thus added one to the many valuable hand-lists now being published in various parts of the United States. The need of monographs and synonymic lists in the present day is constantly making itself felt; without them the entomologist can scarcely keep pace with the rapid growth of his study; so that he hails the appearance of such a paper as the above, with its well-executed and clearly-defined plates, as a godsend, for which he can hardly be too grateful.

THE additions to the Zoological Society's Gardens during the past week include a Brown Monkey (*Macacus brunneus*) from Siam, presented by Mr. Thos. G. F. Hesketh; a Tyrant Eagle (*Spizaëtus tyrannus*) from South America, a Many-zoned Hawk (*Melierax polyzonus*) from East Africa, two Brazilian Caracaras (*Polyborus brasiliensis*), white variety, from Patagonia, presented by Lord Lilford; two Common Pintails (*Dafila acuta*), three Spotted-billed Ducks (*Anas pœciiorhyncha*), eighteen Red-crested Whistling Ducks (*Fuligula rufina*) from North-west India, presented by Mr. E. C. Buck; a Ring-necked Parrakeet (*Palæornis torquata*) from India, presented by Mrs. Henry Kingston; a Cape Dove (*Ænа capensis*) from Africa, presented by Miss Barrer; an Indian Elephant (*Elephas indicus*), a Secretary Vulture (*Serpentarius reptilivorus*) from South Africa, deposited; a Greenland Falcon (*Falco candicans*) from Greenland, purchased; a Great Kangaroo (*Macropus giganteus*), a Red Kangaroo (*Macropus rufus*), born in the Gardens.

ANNIVERSARY ADDRESS OF THE PRESIDENT OF THE ROYAL GEOLOGICAL SOCIETY, JOHN EVANS, F.R.S.[1]

II.

MR. EVANS, in continuing his address, spoke of stratigraphical geology and of palæontology, expressing his belief that all recent discoveries pointed to uninterrupted continuity in both regions. After briefly referring to the evidence found in Settle Cave of the pre-Glacial existence of man in this country, and to the Wealden boring, Mr. Evans spoke as follows:—

There is only one more subject on which I will say a few words, and which, as to some slight extent involving a question in which I am personally interested, I have kept for the end of my address.

It is one to which it appears probable that the earnest attention of geologists will immediately be called, namely, the water-supply of this vast metropolis. This is, indeed, not the first time that the attention of this Society has been called to it; for Professor Prestwich devoted to it a considerable portion of his presidential address in 1872. It has since been more fully discussed in the Sixth Report of the Commissioners appointed in 1868 to inquire into the best means of preventing the pollution of rivers, who have extended their inquiries somewhat beyond

[1] Continued from p. 356.

what appear to be the strict limits of their Commission. It is with their report that I am mainly concerned.

The Commissioners have expressed their opinion that the rivers Thames and Lea (or Lee, as the word is spelt in their Report) ought to be abandoned as early as possible, and especially the former, as sources of supply to London. They regard the condition of these rivers as hopeless, and point out that an abundance of spring- and deep-well water can be procured in the basin of the Thames and within a moderate distance of London; and they are further of opinion that the metropolis and its suburbs should be supplied, on the constant system, exclusively with this palatable and wholesome water.

They believe that within forty miles of St. Paul's a sufficient volume of deep-well and spring-water can be obtained for the present daily wants of the metropolis, but especially point to the chalk and upper green-sand above the Gault, as the sources of supply. They state that within thirty miles of London there is an area of 849 square miles "covered" by these formations, and that within 40 miles radius the area is 1,597 square miles.

They estimate, to a great extent guided by experiments carried on during many years under my superintendence, that the portion of the annual rainfall upon this large extent of porous rock, which sinks to reappear in springs and streams, may be taken at six inches annually, and point out that this amount of infiltration into the chalk area within thirty miles of the metropolis indicates the quantity of 202 millions of gallons daily, as the theoretical maximum supply available from that area. They suggest that the greater portion of this water, which now escapes in springs and in the river-beds at the lower levels of the absorbent district on which it falls, might be abstracted by a sufficient number of wells sunk below the present spring-heads of the district, and so constantly drawn upon, that there should always be a void for the reception of unusual rainfalls below the level at which the drainage of the district naturally escapes. They incidentally admit that any water drawn from the subterranean reservoir in the chalk by artificial means will be at the expense of the streams which now flow through the valleys in the chalk area, but do not give even a passing consideration to the effect upon that area of abstracting from it its natural supply of water, and conveying it —"convey, the wise it call"—to London—should the scheme they advocate ever be carried into effect.

It can hardly be believed that a proposal such as this, involving the diversion of the whole of the water from the natural springs and streams over an area of not less than 440 square miles—an area larger than that of several English counties—should have been brought forward without the slightest reference to what would be the result upon this vast extent of country, the inhabitants of which are to be sacrificed to the presumed needs of this overgrown city. It will, I think, come within the province of the geologist to point out not only where spring-water of good quality is to be obtained, but also what will be the effect of its abstraction upon the districts where it now exists in sufficient abundance to overflow into the streams. It will be for him to show what will be the effect of producing "a void below the level at which the drainage of the country naturally escapes;" how what are now fertile and even irrigated meadows will be converted into arid wastes; how watercress beds, now of fabulous value, will be brought to the resemblance of newly-mended turnpike roads; how in such a district all existing wells, many of them already some hundreds of feet in depth, will be dried, the mill-streams disappear, and even the canals and navigable rivers become liable to sink and be lost in their beds. And these results would, if the scheme were carried out, not be confined to some single spot, but would extend over hundreds of square miles.

It may perhaps be thought that I am exaggerating the size of the area, the natural water-supply of which it is proposed to abstract; but the calculation may be readily verified.

The quantity of water now daily supplied to London by the different water-companies, exclusive of the Kent Company, which already supplies deep-well water to the extent of 9,000,000 gallons daily, is stated to be 104,800,000 gallons. Now if the supply of 6 inches of rainfall per annum, absorbed over 849 square miles, be, as the Commissioners calculate, equivalent to 202,000,000 gallons daily, it is evident that it will require more than half that area to furnish 104,800,000 gallons daily, the exact figures being 440½ square miles.

It must, however, be remembered that the Commissioners regard this quantity as the theoretical maximum of water-supply available from such an area. And they are right in so doing; for in some years a far larger area would have to be exhausted in order to produce so large a water-supply, since not unfrequently the quantity of the rainfall which percolates to a depth of only 3 feet into the soil, instead of being 6 inches, as supposed in the calculation, is as low as 3 inches. For three years running I have known the percolation through a depth of 3 feet of ordinary soil covered with vegetation to have been on the average only 3½ inches, and through chalk under the same conditions, less than 5¼ inches. It would appear then that it would be safer to regard the available spring-water supply as not representing more than 4 inches of the rainfall per annum, instead of 6 inches, in which case the area requisite to supply 104,800,000 gallons daily would be 660 square miles.

To avoid any possible error, let us look at the matter from another point of view. One inch of rain falling over a statute acre produces, as nearly as may be, 100 tons, or 22,400 gallons of water. Dividing this by 30 as representing the daily consumption of one person, there would be enough for one person for 743 days, or, say, for two for one year. Four inches of rain would render each acre capable of supplying the wants of eight persons, so that a square mile of 640 acres would supply 5,120 persons for one year. Calling the population of the metropolitan area 4,000,000, and dividing that number by 5,120, we arrive at an area of 780 square miles as necessary for their supply.

There can therefore be no doubt as to the vast extent of country which the proposal of the Commissioners would place under unnatural conditions with regard to its springs and streams.

No doubt wells may, in some few instances, be placed in such a position as to affect but slightly the neighbouring streams. The wells of the Kent waterworks, for instance, which supply 9,000,000 gallons daily, are so placed as mainly to derive their supply from water that would otherwise find its way into the Thames by springs along its bed; indeed, from the amount of chlorine present in the water, it may be doubted whether some portion of it is not derived from the Thames itself by filtration through the chalk. It seems probable that in the valley of the Thames immediately above London there may be spots from which a limited supply of water might be pumped without much injury to the neighbouring property; but a wholesale abstraction of the entire supply of spring-water from an area of even 300 or 400 square miles could not be otherwise than most disastrous.

On looking at the actual chemical analysis of the waters supplied by the different companies, as furnished by the Commissioners, there would at first sight appear to be some difficulty in understanding their reasons for so highly commending the Kent Company's water, and so unhesitatingly condemning that of the other companies, if we are to take as our guide the "previous sewage or animal contamination," on which so much stress is laid. It is hard to comprehend why, if river or flowing water which exhibits any proportion, however small, of "previous sewage or animal contamination," is to be regarded as suspicious or doubtful, the water in wells, say 100 feet deep, may be allowed 10,000 pints in 100,000, or 1 pint in 10, and may yet be regarded as reasonably safe. For, in these deep wells, if at no great distance from a river such as the Thames, it by no means follows that there is not some amount of comparatively direct communication through which water may trickle rather than filter, and not improbably the river-water below London is more objectionable for drinking purposes than it is higher up the Thames.

Let us for a moment compare the "previous sewage or animal contamination" of the water supplied by the different companies deriving their water from the Thames and Lea with that of the Kent Company's water. I take the average of the different analyses of each, as given at p. 270 *et seq.* of the Report:—

West Middlesex	3·083
Grand Junction	3·226
Southwark and Vauxhall	2·983
Lambeth	3·081
Chelsea	2·785
New River (excluding 1868)	2·751
East London	2·304
Average	2·888
Kent Company	6·480

or upwards of twice that of any one of the other Companies.

In this average, however, is included the water from the wells at Charlton and Belvedere, both of which are condemned

by the Commissioners. Omitting these two, the average is 3·780, which is still far higher than any of the others.

If we refer to the headings Organic Carbon and Organic Nitrogen, there can be little doubt of the superiority of the Kent Company's water, but judging merely from the statistics under the awful heading of "Previous Sewage Contamination," that of the River Companies seems the purest.

Why the source of supply from the two rivers should be condemned as hopeless it is hard to determine. This startling recommendation to give up the supplies of water on which London for centuries has depended, is brought forward just at a time when the most strenuous efforts are being made to purify the rivers Thames and Lea, and but a few years after the Commissioners on the Water Supply of the Metropolis, within whose proper sphere this question lay, had reported that with perfect filtration and efficient measures taken for excluding from them the sewage and other polluting matter, these rivers will afford water which will be perfectly wholesome and of suitable quality for the supply of the metropolis.

It is not for me to enter into the chemical part of this question, but I may venture to express a doubt whether considerably more might not be done by increased reservoirs for subsidence, and by artificial aëration of the water, in addition to filtration, so as to carry still farther the oxidation of any organic matter it may chance to contain.

I have less hesitation in strongly insisting on the fact that, irrespective of the New River water, the metropolis is already supplied with 9,000,000 gallons per diem, or at least 2¼ gallons per head, of the deep-well water so highly commended, a quantity which would seem amply sufficient for dietetic and culinary purposes. I am, moreover, of opinion that the difficulty of distributing this water over the whole area by means of a second service distinct from that of the water for ordinary domestic purposes, though great, is by no means insurmountable. Even were the waters of the Thames and Lea unfit for drinking purposes, it is very far from being the case, that London is in the same plight as Coleridge's "Ancient Mariner," with—

> "Water, water everywhere,
> Nor any drop to drink."

Enough is already there for all culinary and dietetic purposes, could it but be distributed; and to lay out incalculable sums of money and inflict incalculable mischief, in order to import chemically pure water with which to lay the dust in our streets, and to flush our sewers, seems "a multiplying improvement in madness, and use upon use in folly." We might almost as well import wine for the purpose; and in that case the Commissioners might find a historical parallel in the proclamation of Jack Cade:—"Here, sitting upon London Stone, I charge and command, that of the City's cost, the conduits run nothing but claret wine the first year of our reign."

As deeply interested in the water-power and general prosperity of one of the chalk valleys within the fated radius of thirty miles, I may have spoken strongly on this question, and may not unfairly be accused of having done so from interested motives. No one, however, can submit silently to an insidious attack upon the property which he is fairly entitled to hold; and after carrying on experiments, for upwards of twenty years, as to the percolation of water to the underground springs in a chalk area, I may claim some experience in such a question, and much doubt whether my judgment is seriously distorted. Even should the abstraction of water be spread over a much larger area than has been supposed, so as to reduce the amount conveyed away from any particular district; or even should the gross quantity required prove less than supposed, it may be left to any one who will take the trouble to investigate the matter, to determine whether the effects if wider spread, or somewhat diminished in intensity, would be much less injurious. Any injury from this cause would moreover be felt with double intensity at those seasons, which are of by no means unfrequent recurrence, when even without this gigantic artificial abstraction, the water in the upper portions of the chalk district becomes short, and wells which during the previous season may have had fifty or sixty feet of water in them run absolutely dry.

It now only remains for me to thank the Council, the officers of the Society, and the fellows at large, for the uniform kindness and consideration which they have extended to me, not only during the two years I have had the honour of being your president, but during the eight preceding years, during which I was one of your secretaries. I look back with pleasure on the prosperity which, during those ten years, the Society has enjoyed, a prosperity which I hope may continue even in a greater degree, now that I quit this chair in favour of my old friend and fellow-secretary, Prof. Duncan, who is, in all respects, so thoroughly well qualified to fill it.

SCIENTIFIC SERIALS

THE *Journal of the Chemical Society* for January contains the following papers:—Isomeric terpenes and their derivatives (Part V.), by G. H. Beckett and C. R. A. Wright, D.Sc. The authors in this paper describe the results of their experiments upon peppermint camphor from Japan. This substance has been shown by Oppenheim to be an alcohol (menthylic alcohol) of the formula $C_{10}H_{19}OH$, which by the action of dehydrating agents yields menthene, $C_{10}H_{18}$, this latter substance when treated with bromine yielding a tetrabromide $C_{10}H_{18}Br_4$, which on heating splits up into hydrobromic acid and cymene. The cymene thus obtained is identical with those previously obtained from other bodies. The authors have examined also the toluic acid from seven different cymenes, and conclude therefrom that "by the action of a large number of agents on terpenes and bodies related to them, absolutely the same cymene results, this cymene being identical with the paramethylpropyl benzene recently obtained synthetically by Fittica." Clove oil hydrocarbons and the liquid oil from camphor sublimation have also been examined.—On the decomposition of stearic acid by distillation under pressure, by George Johnston. The oils produced contain, among other products, mixtures of seven paraffins with the corresponding olefines.—On tolyl-phenyl, a new hydrocarbon, by T. Carnelley, B.Sc. The hydrocarbon is produced by the action of sodium upon a mixture of bromobenzene and pure bromotoluene (1 : 4):—

$$C_6H_5Br + C_6H_4.CH_3Br + Na_2 = 2NaBr + C_6H_4 \begin{cases} CH_3 \\ C_6H_5 \end{cases}$$

The behaviour of this hydrocarbon on oxidation is described, and and also some of its nitro and amido substitution derivatives.—A simple form of gas regulator for maintaining a constant temperature in air-baths, water-baths, incubators, &c., by F. J. M. Page, B.Sc.—The remainder of the journal is devoted to abstracts from foreign periodicals.

THE January number of the *Ibis* commences with a paper by Mr. Robert Ridgway, of the Ornithological Department of the United States National Museum, Washington, entitled "Second Thoughts on the genus *Micraster*," in which he modifies his view previously expressed as to the reduction of the number of species, from an examination of the specimens in Messrs. Salvin and Godman's collection. The same author also writes on the genus *Glaucidium*, embodying the results of Mr. Sharpe's criticism of a previous paper by him on the same subject; *G. jardinii* is figured.—Mr. D. G. Elliot has remarks on some type specimens of Trochilidæ from the museums of Neuchâtel and Florence; and notes on the Trochilidæ. In the former paper three of Tschudi's types—*Bourcieria insectivora*, *Heliodoxa leadbeateri*, *Leucippus leucogaster*—are discussed. The male of the first is described; *Trochilus otero* (Tschudi) is the second; the third is one of two species only of the genus. Four of Sig. Benvenuti's types are described. *Mellisuga judith* is *Panoplites flavescens*; *Mellisuga salvadorii* is the female of *Cynanthus cyanurus*, *Mellisuga ridolfii* is a female of *Eriocnemis vestita*, and *Polytmus ceciliæ* is *Campylopterus lazulus*. Mr. Elliot's second paper is on the genus *Lampropygia*.—Mr. C. Bygrave Wharton has Notes on the Ornithology of Corsica, describing 113 species, mostly from the west coast.—Mr. R. B. Sharpe gives Part I. of Contributions to the Ornithology of Borneo, with a plate figuring *Orthotomus borneonensis* and *Calamodyta doriæ*, based on a collection made by Mr. Arthur Everett, *Circus spilonotus*, *Copsychus problematicus* (sp.n.), *Brachypodius immaculatus* (sp.n.), *Herpornis brunnescens* (sp.n.), *Henicurus ruficapillus* are the species described for the first time from the island. Mr. Sharpe also determines two new species of South African birds collected by Mr. F. A. Barratt near the Macamac gold-fields. They are *Andropadus flavostriatus*, and *Bradypterus barratti*.—Mr. J. H. Gurney continues his notes on Mr. Sharpe's Catalogue of the Accipitres in the British Museum, discussing the Buteoninæ.—Mr. H. E. Dresser gives notes on Severtzoff's Fauna of Turkestan.—Prof. Newton writes on the assignation of a type to Linnean genera, with especial reference to the genus *Strix*.—Messrs. H. Seebohm and J. A. Harvie Brown give notes on the birds of the Lower Petchora, based on an expedition made there last summer.